of ossicles; or, in rare cases (*Amphoracrinus*), tunnelled in the substance of the greatly thickened walls of the vault. These internal passages, usually reduced in number to five by uniting with one another, pass into the internal mouth, into which they doubtless lead the current from the ciliated brachial grooves.

In connection with different species of *Platyceras* with various crinoids, over whose anal openings they fix themselves, moulding the edges of their shells to the form of shell of the crinoid, is a case of "commensalism," in which the mollusc takes advantage for nutrition and respiration of the current passing through the alimentary canal of the echinoderm. *Hyponome Sarsii* appears, from Prof. Lovén's description, to be a true crinoid, closely allied to *Antedon*, and does not seem in any way to resemble the Cystideans. It has, however, precisely the same arrangement as to its internal radial vessels and mouth which we find in the older crinoids. It bears the same structural relation to *Antedon* which *Extracrinus* bears to *Pentacrinus*.

Some examples of different tesselated crinoids from the Burlington limestone, most of them procured by Mr. Wachsmuth, and described by Messrs. Meek and Worthen, show a very remarkable convoluted plate, somewhat in form like the shell of a *Scaphander*, placed vertically in the centre of the cup, in the position occupied by the fibrous axis or columella in *Pentacrinus* and *Antedon*. Mr. Billings, the distinguished palæontologist to the Survey of Canada, in a very valuable paper on the structure of the Crinoidea, Cystidea, and Blastoidea (*Silliman's Journal*, January 1870), advocates the view that the plate is connected with the apparatus of respiration, and that it is homologous with the pectinated rhombs of Cystideans, the tube apparatus of Pentremites, and the sand-canal of Asterids. Messrs. Meek and Worthen and Dr. Lütken, on the other hand, regard it as associated in some way with the alimentary canal and the function of nutrition.

The author strongly supported the latter opinion. The perivisceral membrane in *Antedon* and *Pentacrinus* already alluded to, which lines the whole calyx, and whose involutions, supporting the coils of the alimentary canal, contribute to the formation of the central columella, is crowded with miliary grains and small plates of carbonate of line; and a very slight modification would convert the whole into a delicate fenestrated calcareous plate. Some of the specimens in Mr. Wachsmuth's collection show the open reticulated tissue of the central coil continuous over the whole of the interior of the calyx, and rising on the walls of the vault, thus following almost exactly the course of the perivisceral membrane in the recent forms. In all likelihood, therefore, the internal calcareous network in the crinoids, whether rising into a convoluted plate or lining the cavity of the crinoid head, is simply a calcified condition of the perivisceral sac.

The author was inclined to agree with Mr. Rofe and Mr. Billings in attributing the functions of respiration to the pectinated rhombs of the Cystideans and the tube apparatus of the Blastoids. He did not see, however, that any equivalent arrangement was either necessary or probable in the crinoids with expanded arms, in which the provisions for respiration, in the form of tubular tentacles and respiratory films and lobes over the whole extent of the arms and pinnules, are so elaborate and complete.

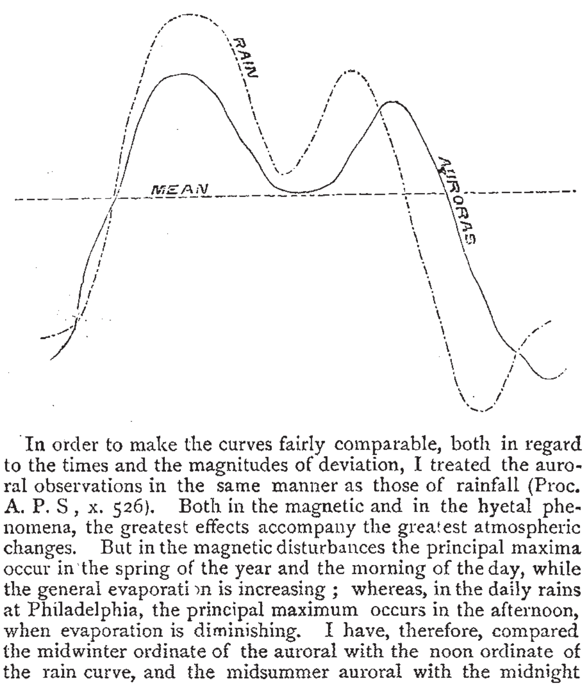
ON THE RELATION OF AURORAS TO GRAVITATING CURRENTS*

PROF. LOOMIS'S observations of the number of Auroras in each month of 1869 and 1870 (*American Journal of Science*, 3rd S., i. 309) are specially noteworthy, both because of the careful accuracy of the observer, and because they are the first published observations which furnish satisfactory data for an approximate determination of the laws of auroral distribution.

If the auroras are, as is now generally believed, luminous manifestations of terrestrial magnetism, it seems reasonable to look to them for some additional evidence upon the question of the relation between magnetic and gravitating currents. Messrs. Baxendell and Bloxam have already pointed out some resemblances between hyetal and magnetic curves (see Proc. A. P. S., x. 368) and if analogous resemblances can be traced between hyetal and auroral curves, they will be interesting and suggestive.

I have not found the similarity between the annual distribution of rainfalls and auroras sufficiently striking to impress any one who has not made a special study of the causes of resemblance and difference. But, as I have repeatedly urged, currents are subject to an increased number of disguising disturbances, in proportion to the sluggishness of their motion, and the time which is consequently required for their formation and change. We may very reasonably look for analogies between the daily and the annual auroral or magnetic curves, of a character for which we could hope to find no parallel in wind, rain, or ocean current curves.

If we desire, therefore, to find evidence of the joint influence of solar expansion and gravitating equilibrium, we should look where it is most likely to be found, and to the best of the observations which may be supposed to be fairly comparable. There are similar variations of solar attitude, and consequently increasing and diminishing solar force, in the day and in the year, but the effects of these variations upon the precipitation of vapour are more likely to be shown in their greatest simplicity by the means of observations at different hours of the day than at different seasons of the year. I know of no published observations of this character at New Haven, but there are some extending over a long series of years at Philadelphia and at Greenwich, the curves at each station indicating minima of rainfall at noon and midnight, and maxima in the morning and evening. The difference of longitude between Philadelphia and New Haven being less than $2\frac{1}{2}°$, it is not likely that there is any material difference in the daily rain-curves at the two places.



In order to make the curves fairly comparable, both in regard to the times and the magnitudes of deviation, I treated the auroral observations in the same manner as those of rainfall (Proc. A. P. S, x. 526). Both in the magnetic and in the hyetal phenomena, the greatest effects accompany the greatest atmospheric changes. But in the magnetic disturbances the principal maxima occur in the spring of the year and the morning of the day, while the general evaporation is increasing; whereas, in the daily rains at Philadelphia, the principal maximum occurs in the afternoon, when evaporation is diminishing. I have, therefore, compared the midwinter ordinate of the auroral with the noon ordinate of the rain curve, and the midsummer auroral with the midnight hyetal ordinate.

The auroral observations and the normal ordinates of the accompanying curves are given in the following table. I presume no one will doubt that the condensation of vapour, which is represented by the rain-curve, is occasioned by the simple operation of gravitation in blending currents of different temperatures, and I see no reason for postulating any different law for the development of electricity and magnetism in the aurora.

Comparative Table of Auroras and Rainfalls

Month.	No. of Aurorals.	Normals.	Hours.	Normals of Rain.
		88	0	91
January . .	32	90	1	91
		94	2	93
February . .	31	98	3	98
		103	4	105
March . . .	41	107	5	110
		109	6	113
April . . .	44	109	7	113
		108	8	112

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* Read before the American Philosophical Society, May 5, 1871, by Pliny Earle Chase.

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Month.	No. of Aurorals.	Normals.	Hours.	Normals of Rain.
May	36	106	9	109
		103	10	105
June	31	101	11	102
		100	12	103
July	38	101	13	106
		103	14	109
August	34	105	15	108
		107	16	104
September	43	106	17	98
		103	18	92
October	38	100	19	87
		95	20	85
November	27	91	21	87
		89	22	90
December	30	87	23	91

SCIENTIFIC SERIALS

Jahrbuch der kaiserlich-königlichen geologischen Reichsanstalt. Vol. xvi. No. 1. (Vienna.) The first paper in this part of the *Jahrbuch* is one by Prof. Kreuz, "Das Vihorlat-Gutin-Trachytgebirge." This is one of those painstaking lithological papers which are less commonly met with in our own scientific journals than one could wish. The author has carefully examined under the microscope the trachytic rocks of the Vihorlat-Gutin mountains of North-eastern Hungary, a range which stretches from north-west to south-east in the same direction as the Carpathian Sandstones. He groups the rocks under three divisions:—(1) Augite-andesite; (2) Sanidine-oligoclase-trachyte; (3) Breccias and Tuffs; and his descriptions of the two former are particularly full and interesting. The breccias and tuffs are necessarily less susceptible of clear concise description; they appear to vary as much and in as short a space as similar volcanic accumulations elsewhere.—Prof. Koch, of Ofen, contributes "Beitrag zur Kentniss der geognostischen Beschaffenheit des Urdniker Gebirges," an isolated little mountain range, which stretches between the Danube and the Save in East Sclavonia. He describes the Tertiary strata he examined in his last visit to that district as being grouped round the foot of the hills. The beds are of marine, fresh, and brackish-water origin. He does not determine their exact geological horizon, but gives lists of the fossils he obtained. The paper concludes with an account of a mass of sanidine-trachyte, which the author believes to be of Tertiary age.—A paper on *Aulococeras Fr. V. Hauer*, by Dr. Edm. von Mosjsisores, is illustrated with four lithographic plates. This and the following paper "On the Tertiary Formation of the Vienna Basin," by Theodor Fuchs and Felix Karrer we recommend to the attention of our palæontologists. Fuchs' and Karrer's paper is most elaborate, and contains copious lists of fossils which, besides being interesting in themselves, are useful for purposes of comparison. The *Jahrbuch* concludes with "Studien aus dem Salinargebiete Siebenbürgens," by F. Posepny; this, however, is only the second part of the paper, the first part having been published so far back as 1867. These saliferous regions are described in considerable detail, and numerous chemical analyses are given. A map, and sections, &c., accompany the paper. We should mention that the *Jahrbuch* includes obituary notices of two former members of the Institute, the well-known Wilhelm Haidinger, and Urban Schloenbach, an enthusiastic palæontologist and geologist who was cut off at the early age of thirty-one.

THE three numbers of the *Quarterly Journal of Microscopical Science* of the present year contain a number of valuable original contributions to science, besides transactions, chronicles of the progress of histology and micro-zoology, and various reviews and short notes and memoranda. In the January number Prof. Allman describes a new mode of reproduction by fission in a new hydroid polyp, which he figures in a plate.—Haeckel's researches on the nature of Coccoliths and Bathybius are noticed at length, and the remarkable Radiolarian *Myxobrachia* is figured in a tinted plate.—Mr. Archer, of Dublin, to whose researches published in the same journal in 1869 we owe our knowledge of a most beautiful and interesting group of fresh water Protista—the Heliozoa—contributes to the April number a further account of new fresh water rhizopods, illustrated with two coloured plates.—In the same number Mr. Moseley figures and describes the nerves of the cornea, and Mr. Lankester gives a minute account of the structure and mode of formation of the sperm-ropes of the river Annelids.—In the July number an exceedingly valuable memoir by Dr. Van Beneden appears "On the Development of a Species of Gregarina," which he described last year (also in the Journal). It appears that the Gregarinæ exhibit a young stage when they are devoid of nucleus, and have great activity and worm-like form; to this stage Dr. Van Beneden applies the name *pseudo-filarian.*—In the same number Mr. Sorby gives an elaborate paper on the colouring matters of leaves, which has an appropriate place in a journal devoted to microscopy, since it is only by the micro-spectroscope that many of those colouring matters can be studied on account of their small quantity, and, further, since the application of such methods of analysis to histology as the micro-spectroscope affords is of the very highest importance.—Various points relating to the instrument itself are discussed in these three parts by Dr. Royston Pigott, who figures his aplanatic searcher and its results on the Podura scale; by Messrs. Dudgeon, Newton, and others, who describe new apparatus.—Mr. Moseley gives accounts of how to use gold chloride and silver nitrate in histological research, and how best to prepare and cut sections of the frog's egg for embryological study.—The original paper by Dr. Nitzsche, of Leipzig (illustrated), on the reproduction of the Bryozoa, and the reply to Mr. Hincks, are important, and on a very curious point. It is, however, to the chronicles and notes which we would especially call attention as of service to biological students. Long abstracts of all the important papers published in the German periodicals are to be found—in some cases illustrated by woodcuts; thus we have Neuman on the origin of the red blood corpucles, Kranse on connective tissue, Flemming on fatty tissue, Schöbl on the bat's wing and mouse's ear, Pflüger on the method of demonstrating nerve-endings in the liver and other glands, Exner on the Schneiderian membrane, Cienkowski on the sporogonia of *Noctiluca*, and many other such.

IN the *Journal of Botany* for October, Dr. Braithwaite continues his Recent Additions to our Moss Flora. Mr. R. Tucker gives some Notes on the now well-defined Flora of the Isle of Wight; and Dr. Moore Notes on some Irish Plants. Mr. F. Stratton contributes an article on *Monotropa hypopitys*, confirming the statement of other recent observers that this plant is not truly parasitic. The remainder of the number is occupied by short notes, reviews, reports, and reprints.

THE *Scottish Naturalist* for October opens with a timely reprint of an extract from Mr. Patrick Matthew's work on Naval Timber, published in 1831, and referred to in Darwin's "Origin of Species," in which he distinctly enunciates the theory that "circumstance and species have grown up together," or that new species have arisen from old species adapting themselves to altered circumstances. The most important original articles in the number are: The Baleens, or Whalebone Whales of the North-east of Scotland, by Mr. R. Walker; Notes on the Tetraonidæ of Perthshire, by Mr. R. Paton; On the Altitudes attained by Certain Plants (varying from those already recorded), by Dr. F. Buchanan White; and On Scottish Galls, by Mr. J. W. H. Traill.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 2.—M. C. Jorden read a mathematical paper "On the Classification of Primary Groups." Two papers on subjects connected with physics were read, one by M. A. Cornu, "On the Determination of the Velocity of Light," in which he suggests an improvement in the method proposed by Fizeau for this purpose, and a note by M. G. Salet on the Spectra of Tin and its components, which he describes as the most singular he has ever seen.—On astronomical subjects several communications were made.—M. Chasles replied to a statement made by M. Bertrand at a previous meeting with regard to Aboul Wéfa's method of calculating the position of the moon. M. Yvon Villareau communicated a long paper, full of mathematical formulæ, "On the Determination of the true Figure of the Earth, without the necessity of actual levellings."—M. Delaunay read a note on the two recently discovered planets, Nos. 116 and 117, in which he indicated that the planet discovered at Versailles by M. Borelly, and named Lomia, must be numbered 117, as the planet discovered by M. Luther two days afterwards had been previously detected in America by Mr. C. H. F. Peters.—

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